Hepatitis Among Hospital Employees

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The risk of acquiring hepatitis associated with work in a moderate-sized acute-care teaching hospital was determined by a seroepidemiologic survey of hepatitis B surface antigen and antibody. A blood specimen and a completed questionnaire were obtained from 76 percent of the staff members involved in patient care activities and all preemployment applicants (a total of 767 persons).

One employee was found to have transiently positive tests for hepatitis B surface antigen, whereas 94 (12.2 percent) were found to have hepatitis B surface antibodies. Using the national incidence rate for volunteer blood donors of 4.4 percent as a norm, significantly higher antibody incidence was seen in nursing personnel (16.9 percent), laboratory workers (14.0 percent), surgeons (37.5 percent) and dental workers (40.0 percent). Rates were not significantly raised among house officers, internists, respiratory therapists or housekeeping employees. Increased incidence was statistically related to age and known history of hepatitis, but not to sex, known needle-stick exposure, contact with patients having hepatitis, prior blood transfusion, blood handling or nonhospital exposure to hepatitis. In persons whose tests were positive for antibodies there was a 4 percent increment per decade of age among long-term employees; duration of employment approached significance as a risk factor. Of those with hepatitis B antibody, only 16 percent were aware of a prior bout of hepatitis.

Hepatitis B is among the most common infectious risks of hospital employment,[1] occasioned by contact with patients. Serologic evidence of prior infection among health care workers is two to ten times higher than in the population at large.[2-4] Illness or asymptomatic transmission may occur in hospital staff after caring for patients (or handling their blood or secretions) with either active hepatitis or subclinical disease.[5] Hepatitis has also been transmitted, albeit infrequently, from health workers to patients, with outbreaks traced to dentists, oral surgeons and, in isolated episodes, from a general practitioner, a gynecologist, a nurse and a respiratory therapist.[6-11] Infection may be acquired through close personal contact,[1,9,11] but more commonly occurs following percutaneous inoculation of blood.[12]

Prior studies of hepatitis risk among US hospital health care workers have been somewhat specialized in scope. Serologic surveys have reviewed employees of two large metropolitan hospitals serving predominantly indigent patients[13,14]; prevalence among employees in the National Institutes of Health Clinical Research Center[4]; hospital personnel in two West German hospitals,[3,15] and the staff of an Australian hospital where exceptionally high patient hepatitis rates were found.[2] The occurrence of acute hepatitis has also been monitored among such specialized health care personnel as those employed in mental institutions[16] or a tertiary care hospital.[5] In addition, several studies have surveyed physicians in general[17-19] and specific occupations, including hemodialysis workers,[20] adult and pediatric oncology staff,[21,22] surgeons[23] and laboratory workers.[24]

We wished to clarify the hepatitis risk within a Veterans Administration (VA) Hospital because no review exists for this system. Additionally, few studies of hepatitis antibody prevalence address moderate-sized acute-care hospitals serving a population with low hepatitis incidence. Our further purpose was to determine the influence of other variables such as age, total duration of health care employment, specific occupation, blood handling, known prior contact with hepatitis pa-

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tients, known needle-stick exposure and prior awareness of clinical hepatitis.

Background

The Albuquerque VA Hospital is a 400-bed acute-care hospital with 1,100 employees, about 800 of whom are involved directly in patient care. Ethnic background among patient-care employees is 60 percent white non-Hispanic, 33 percent white Hispanic, 5 percent black and 2 percent other (0.2 percent Asian). Most physician patient care is provided by supervised house staff in continuous rotation among several hospitals. The hospital serves as a referral center for cardiac catheterization, open-heart surgical procedures, hemodialysis and renal transplantation. General medical, surgical and psychiatric inpatient and outpatient services are provided as well as special services in surgical and medical intensive care, coronary care, home and center dialysis, oncology and respiratory care. About 15 to 20 open-heart cardiac surgery patients are operated on each month and 15 patients a month receive blood or plasma for oncologic or hemorrhagic diseases.

Hepatitis B is relatively common in the Albuquerque community, related to known parenteral drug abuse. In the VA Hospital, however, only five to ten patients with newly detected hepatitis B have been treated per year, a rate of 5.5 to 11.0 per 10,000 admissions. In addition, one to five patients receive long-term care in the hepatitis B-positive section of the hemodialysis unit. About 20 to 25 hospital employees a year receive hepatitis B immune globulin because of known exposure.

Materials and Methods

In the 18-month period between June 1979 and November 1980, all employees with patient-care duties and job applicants were requested to participate in an investigation of hepatitis. Employees had blood drawn and were given a questionnaire to determine age, occupation, duration of employment, hospital location of employment, prior history of hepatitis, hepatitis in their family, frequency of blood handling, occurrence of known needle-stick exposure and history of blood transfusions. Subjects having had prophylactic inoculations of hepatitis B immune globulin or immune γ-globulin for needle or mucosal exposure in the past two months were excluded. Tests for hepatitis B surface antigen and antibody were done by radioimmunoassays (Ausria II and Ausab kits, Abbott Laboratories, North Chicago, Ill).

Data obtained were compared with baseline values from a national serologic survey of incidence of hepatitis B surface antigen and antibody among first-time volunteer blood donors in 14 cities in the United States.[25] Data were analyzed for significance using the x^2 test or direct (binomial) probability where applicable.

Results

A blood specimen and a questionnaire response were obtained from 767 of the 848 employees (90.4 percent) determined to be involved directly in health care activities. Among the nonphysicians (see below) those not volunteering for testing were equally distributed by sex and occupation. Only one person was found to have hepatitis B surface antigen. He was unaware of illness and subsequently converted to a positive-antibody state without sequelae. For simplicity of analysis, this person was thereafter considered in the same category as those 94 employees found to have hepatitis B antibodies. This resulted in an antibody incidence among all employees tested of 12.6 percent. Nearly all of the nursing staff, including nurses at higher administrative levels, volunteered for the study. Staff physicians were among the most difficult to enlist in the study; only 75 percent volunteered for sampling, possibly due to anxiety about employment changes dictated by possible hepatitis antigen carriage.

TABLE 1.—*Serologic Evidence of Hepatitis (Hepatitis B Surface Antibody) Related to Health-Care Occupation Compared With National Blood Donor Rates**

Category	Total Tested N=589	Positive for Antibody: Number (Percent) N=80 (13.6)	Level of Significance
Physicians	181	15 (8.3)	NS
Medical	28	3 (10.7)	NS
Surgical	8	3 (37.5)	<.01
Pathology	5	1 (20.0)	NS
House officers	140	8 (5.7)	NS
Dentists	5	2 (40.0)	<.05
Dental assistants	8	1 (12.5)	NS
Laboratory workers	50	7 (14.0)	<.01
Radiology	23	3 (13.0)	NS
Nursing	307	52 (16.9)	<.001
Supervisors	8	3 (37.5)	<.01
Operating room	23	6 (26.1)	<.001
Wards	209	32 (15.3)	<.001
Intensive care units	54	7 (13.0)	<.01
Dialysis	13	4 (30.8)	<.01
Building management and engineering	15	0 (0.0)	NS

NS = not significant

*National volunteer blood donor incidence rates of 4.4 percent[25] were used for comparison; statistical analysis by direct (binomial) probability, using a one-tailed test.

Table 1 shows the data concerning rates by category of employment. Compared with the national baseline of 4.4 percent,[25] a significant increase in prevalence was detected among nursing personnel, laboratory workers, surgeons and dentists. Among all physicians, however, only surgeons had a statistically significant ($P<.01$) increased prevalence, though fulltime medical and pathology staff showed a 10 percent and a 20 percent rate, respectively. The rate of 5.7 percent of antibody-positive findings among house officers was close to the national incidence figure for volunteer blood donors. The rate for laboratory workers was significantly above the national comparative standard, but there were no differences among the various types of laboratory workers (for example, microbiology versus hematology versus chemistry sections). Internal check showed frequent job transfer and night-time cross coverage in the laboratory and a uniformly high rate of blood handling.

Nursing personnel of all categories showed significantly raised rates, with the highest (37.5 percent) among supervisors, apparently related to age and duration of occupation. On the other hand, the rates for operating room nurses and dialysis nurses were also significantly higher (26 percent and 31 percent) than the average of all nurses (17 percent), reflecting specific occupational risk. Nurses on surgical and medical intensive care units had no higher prevalence of antibody than general nurses, presumably because of high turnover rates among these units (average stay two to three years). Sampling from preemployment applicants showed a hepatitis B antibody rate of 8.1 percent. Although significantly higher than the national volunteer blood donor rate, most of these potential employees had already been in health care occupations before applying for this job.

Table 2 shows the incidence of hepatitis antibody related to demographic factors of sex, age and duration of employment. Although there were no differences between male and female employees, the age-related differences were significant at the $P<.01$ level. The incidence of hepatitis antibody as related to increased length of employment approaches, but does not reach, statistical significance ($P<.10>.05$). In retrospect, this question was probably not understood as intended, that is, to elicit information on duration of employment at the current ward assignment, rather than total health care employment. Of the other risk factors considered in our questionnaire (Table 3), only the history of hepatitis was significantly related to antibody state, with 16 percent of antibody-positive employees having a history of hepatitis as opposed to a prior hepatitis disease rate of 5 percent of those who did not have antibodies ($P<.001$). A history of blood transfusions, known needle-stick accidents, handling of blood and known (family) hepatitis exposure was not statistically significant relative to positive-antibody status. More than 90 percent of all hospital employees in this survey consider themselves frequent handlers of blood, decreasing the chance that this response would detect differences. Of the 35 employees with a personal history of hepatitis, several undoubtedly did not have hepatitis B, as 22 did not have antibodies to hepatitis B. Of the 13 with a history of hepatitis six had the illness before entering the health care field. Furthermore, by this survey, 84 percent of those who had detectable antibody had no prior knowledge of hepatitis.

TABLE 2.—*Incidence of Hepatitis B Surface Antigens or Antibodies Among Hospital Employees in Relation to Sex, Age and Duration of Employment*

Category	Number of Employees*	Number Positive	Percent Positive	Level of Significance
Sex†				NS
Male	381	48	12.6	
Female	380	41	10.8	
Age				$P<.01$
20	1	0	0.0	
20-29	158	13	8.2	
30-39	217	21	9.7	
40-49	187	25	13.4	
50 and over	128	27	21.1	
Duration of employment years				$P<.10>.50$
0-9	292	43	14.7	
10-19	88	18	20.5	
20-29	36	2	5.6	
30 and over	13	1	7.7	

NS = not significant

*Totals are not identical due to omission of response on some questions.
†Totals (sex only) include employment applicants as well as current employees.

TABLE 3.—*Hepatitis Exposure by Questionnaire as Related to Hepatitis B Antibody State*

Question	Positive response on questionnaire over total response (percent)*		
	Positive for Hepatitis B Antibody	Negative for Hepatitis B Antibody	Level of Significance
History of hepatitis?	13/79(16.5)	22/411(5.4)	$P<.001$
Previous blood transfusions?	13/95(13.7)	43/368(11.7)	NS
Needle-stick accident?	38/66(57.6)	214/340(62.9)	NS
Handle blood during work?	57/66(86.4)	310/337(92.0)	NS
Hepatitis in family?	9/76(11.8)	51/484(10.5)	NS

*Totals are not identical due to omission of response on some questionnaires. Includes only current employees.

Discussion

This study was undertaken to determine the occupational hazard of hepatitis among hospital employees in a medium-sized, university-affiliated, acute-care hospital serving a population of relatively low disease incidence. Because acute hepatitis may be underreported in subclinical or inapparent cases by up to tenfold,[4,13] risk associated with employment was assessed by seroepidemiologic detection of both antigen and antibody. The incidence of hepatitis antibody among all employees was 12.6 percent and, while slightly lower than that in some surveys,[3] was generally in the range seen in other United States facilities[4,13,14,23] for house staff, surgeons, medical technologists, dentists and nurses.

The 5 to 15 new cases of hepatitis seen in this hospital per year undoubtedly underrepresents the risk to health care workers because many patients with known antigenemia return repeatedly for continued care. This group includes patients receiving renal dialysis and those with chronic hepatitis or who are positive hepatitis B surface antigen carriers who do not have hepatitis. In addition, studies for hepatitis B surface antigen among consecutive adult inpatients would indicate that as many as 83 percent of patients with hepatitis B have mild hepatitis but are not known carriers or detected by routine studies conducted during stay in hospital.[1]

The incidence of seropositive findings was particularly high among surgeons (37 percent), dentists (40 percent), laboratory technologists (14 percent) and nursing personnel (17 percent). These results are in accordance with those found by others. Although the overall rate of 8.3 percent among physicians is about

twice the national rate for volunteer blood donors (4.4 percent), it is significantly below the physician rate reported in Germany and England, except for the surgeons among this group.[3,15,18,23] Surveys of physicians at medical meetings in 1975 and 1976 have shown incidence rates of 18.5 percent[17]; these higher rates may in part result from the self-selection of those particularly concerned because of known exposure. The low rate among house staff (5.7 percent) in our survey undoubtedly reflected their shorter job tenure and younger age and is consistent with the observation of frequent seroconversion during training.[17,25] Among nursing personnel, the highest rates were found in supervisory nurses, dialysis staff and operating room nurses, attesting to the risks incurred during long employment in nursing on the one hand and the higher risks during surgical and dialysis procedures on the other. Although nurses in both medical and surgical intensive care units were significantly more likely to have the antibody than nonmedical workers, their rate was not higher than other nurses' despite known hepatitis risks of this occupation.[11,15] This unexpected finding may in part be due to the very high turnover among personnel in intensive care units. Among nursing personnel in particular, there is a high rate of change from one nursing unit to another within the hospital leading to a methodologic problem in attributing risk.

Hospital areas with high risk of occupational exposure included surgery (both operating room nurses and surgeons), laboratory (including pathologists) and hemodialysis. These areas have been cited frequently for risks primarily caused by accidental inoculation or splash-exposure to antigen-positive blood.[1,4,12,13,20,24,26] Unlike previous studies in West Germany,[3] occupation in building management (cleaning services) did not increase the apparent chance of acquiring hepatitis. Age was very significantly associated with the risk of having the antibody in this survey (see Table 2). Thus, 8 percent of all employees in the 20- to 29-year-old range were antibody-positive, whereas those aged 50 years or older had a 21 percent rate, a nearly linear 4 percent increase per decade. A limited recheck of older persons with positive titers indicated that almost all had been employed for their entire adult lives in hospital-related health care. Duration of employment appears to be related to risk of incurring hepatitis; the 4 percent increment per decade most likely reflects hospital contact rather than hepatitis B being incurred in the community.[25]

Although 31 percent of physicians in other studies[17] have indicated that they recalled earlier hepatitis, we found only 10 percent among physicians in this survey. Similarly, only 16.5 percent of all hospital workers in whom antibodies were detected could recall a history of hepatitis. Because 5.4 percent of those who had negative antibody titers had a similar history, at least a third of such histories would appear to be due to hepatitis non-B disease. This would indicate an apparent to inapparent hepatitis B infection ratio of about 10:1. Furthermore, personnel who had antibodies generally were not aware of a critical incident (needle-stick or mucosal exposure) involving a patient with hepatitis. Thus, much of the risk incurred by hospital employment comes from work with patients (or specimens) not recognized as having hepatitis and results in asymptomatic seroconversion.

The rate of antigenemia seen in this study (0.1 percent) was surprisingly low in view of the active dialysis unit—which contains patients who have active hepatitis in a segregated section—and an active oncology unit. Rates of about 1 percent have been found in other surveys of hospital personnel.[2-5] Possible reasons for the low rate of hepatitis B surface antigen among employees include use for the past four years of hepatitis B immune globulin following mucosal splash or needle-stick exposure to antigen-positive blood. During this interval, about 20 to 25 episodes per year of known exposure (predominantly via needle-stick and often involving several persons exposed to the same patient) have required treatment with hepatitis B immune globulin. Among the employees given hepatitis B immune globulin, there have been no known subsequent cases of hepatitis in the past four years, in line with the reduction found in the VA collaborative study.[12] For the past seven years, patients in the hemodialysis unit who have hepatitis B surface antigenemia have been segregated and, whenever possible, cared for by personnel known to have antibodies.[20,27]

With the development of an effective hepatitis B vaccine, the importance of detecting high-risk occupations and sites within a hospital increases. Although infrequent, the transmission from medical staff to patients is also now well documented.[6-11] Early studies clearly indicate both the immunologic potency of the hepatitis vaccine[28] and its efficacy in protecting dialysis personnel and patients.[29] In a hospital similar to ours, vaccine would be used extensively for high-risk groups, with priority for distribution going first to surgeons, dental staff, operating room nurses and dialysis workers. In the next priority category would be laboratory technicians, intensive care unit nurses and all other nurses, with the last priority being all other physicians, including nonsurgical house officers. On a cost-effectiveness basis, vaccine should only be given after determination that the titers of these high-risk staff are antibody-negative. This is based on a current price of about $100 per course of vaccine per employee, an incidence rate of 12 percent for current employees, and an estimated $8.00 for hepatitis B surface antibody per test. Thus, excluding 12 antibody-positive employees per 100 would save $1,200 of vaccine costs at less than $800 hepatitis B antibody test costs. The expense of such a vaccination program may in part be defrayed by the reduction in use of hepatitis B immune globulin; in our hospital 18 of 26 employees given hepatitis B immune globulin in the past year were in high-risk categories. Vaccine cost must also be prorated over the lifetime of its protection (at least five years).[30] Coupled with reduced hepatitis B surface antigen testing after exposure, vaccine use thus approaches the cost of current pro-

tective measures for hepatitis-exposed hospital personnel.

In summary, we have shown that for a medium-sized teaching hospital with a primary and tertiary mix and house staff and nursing teaching functions, the risks of incurring hepatitis are strongly related to age (and probably duration of hospital employment) with an increment of about 4 percent per decade of work in the health-related field. Most risk appears to come from unrecognized cases of hepatitis without known needlestick exposure and 83 percent of the hepatitis that occurs among employees (as detected by antibody state) is asymptomatic or unrecognized. Service areas of highest risk include dialysis units, operating room, laboratories and dental units, with a probable increased risk in intensive care units. Physicians and nurses at highest risk include surgeons, pathologists, operating room nurses and dialysis nurses. Low (or normal) rates were found among medical staff physicians, cleaning personnel and house officers.

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